**ORIGINAL**

HENRY GOLDBERG
JOSEPH A. GODLES
JONATHAN L. WIENER
HENRIETTA WRIGHT
MARY J. DENT
DANIEL S. GOLDBERG

THOMAS G. GHERARDI, P.C.
COUNSEL

EX PARTE OR LATE FILED RECEIVED

(202) 429-4900
TELECOPIER:
(202) 429-4912

**MAY 18 1994**

FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

May 18, 1994

Mr. William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, D.C. 20554

     Re:    GEN Docket No. 90-314
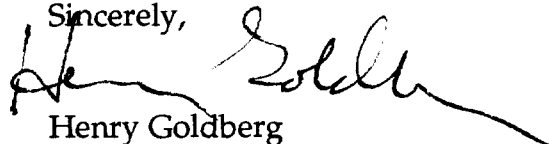           *Ex Parte* Presentation

Dear Mr. Caton:

On May 6, 1994, Apple Computer, Inc. sent a copy of the attached materials to Donald Gips and Robert Pepper. In addition, Apple provided to Dr. Gips and Mr. Pepper copies of three videotapes discussing uses of computers in education. These videotapes are entitled "Wireless Coyote (Diet Version) An Investigation by Apple Classrooms of Tomorrow," "Kids, Cameras and Computers," and "Cloud Forest Classroom: An Investigation into Wireless Computing."

Two copies of this letter and the attached materials, and one copy of the videotapes, are hereby submitted for the public record in this proceeding, pursuant to 47 C.F.R. § 1.1206(a)(1). These materials were sent by Apple to the undersigned at the same time they were sent to Dr. Gips and Mr. Pepper, and are being filed promptly upon their receipt.

If there are any questions in this regard, please contact the undersigned.

          Sincerely,

          Henry Goldberg

No. of Copies rec'd 0+1
List ABCDE

May 6, 1994

Dr. Don Gips
Deputy Chief of Office
Plans and Policy
FCC
1919 M Street, N.W.
Washington, D.C.


Dear Don,

Thank you for meeting with us last week. As you can tell, we care deeply about education and the appropriate integration of technology. We've learned a lot from our years of working with educators, and we think the information we've gained would be helpful in your endeavors.

I hope our meeting represents the beginning of a mutually beneficial dialogue between Apple and you. The dialogue might include such topics as the effective uses of technology in education—both now and in the future, barriers to achieving technology integration and equity, and national initiatives.

As we discussed, seeing something in action is always more compelling than hearing it described. To help you get first-hand experience with some exceptional implementations of technology use in education, I've included a list of sites that you might visit.

To start the information flow, I've also enclosed the materials that we discussed.

• Apple Education Research Series—Effectiveness Reports
• The ACOT Information Packet
• Kids, Cameras, and Computers (a short video)
• Cloud Forest Classroom (wireless communications video)
• Wireless Coyote (wireless communication video)

In addition, under separate cover, we will be sending you the latest issue of education publication, The Computing Teacher (theme: online collaboration).

I look forward to continuing our work together. Sue Collins, of my office, will provide whatever assistance you need from the Education Division. You can reach her at (408) 974-2137.

Sincerely,

Cheryl A. Vedoe
Vice President and General Manager, Education Division
Apple Computer, Inc.

cc:     Jim Burger, Government Affairs
        Sue Collins, Education Division
        Henry Goldberg, Goldberg, Godles, Weiner, & Right
        Jackie Robinson, Government Affairs

May 6, 1994

Mr. Robert Pepper
Chief of Office
Plans and Policy
FCC
1919 M Street, N.W.
Washington, D.C.

Dear Mr. Pepper,

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Vice President and General Manager, Education Division
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cc:     Jim Burger, Government Affairs
        Sue Collins, Education Division
        Henry Goldberg, Goldberg, Godles, Weiner, & Right
        Jackie Robinson, Government Affairs

Peakview Elementary School
Cherry Creek School District
19451 E. Progress Circle
Aurora, CO 80015
(303) 766-1996
Contact:     Karen Peterson

Peakview Elementary, a K-5 school, has been open for three years and has hosted approximately 1500 national and international visitors. Peakview is a literature-based environment with an emphasis on technology. There are 4-6 Macintoshes computers in each classroom networked across the building to access and update student electronic portfolios. The students are in multi-age groupings and work with many forms of technologies to support their teaching and learning objectives.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Calloway County Middle School
(NASDC/ACOT-Teacher Development Center)
2108-A Copllege Farm Road
Murray, KY 42071
(502) 753-4182
Contact:     Marilyn Willis, Principal

Excellent implementation of portable computers in the middle school. 100 PowerBooks are used by students and teachers across the curriculum Walk into any classroom and you'll find PowerBooks on tables and desks being used in science, math, language arts. PowerBooks are checked out through the library, and used in classrooms, as needed, as well as taken home by students to do assignments. The PowerBooks makes teacher inservice very easy because teachers can take computers home anytime.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Ralston High School
Ralston School District
8545 Park Drive
Ralston, Nebraska 68127
(402) 331-4700
Contact:     Mike Burns

Students and faculty at this 900 student high school have been given ready access to the current information highway, as well as ready access to the district's internal network. The infusion of technology into the curriculum at the school is so great, that almost 60% of all student work is turned in electronically.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Sioux Falls Public Schools
201 East 38th Street
Sioux Falls, South Dakota 57117
(605) 339-6023
Contact:       Mike Christensen

All elementary and middle school teachers and administrative staff at this
district have been given portable computers, (PowerBooks).  By doing this,
this district has empowered teachers to be part of the information age; to
really understand and appreciate how technology can assist them in the task
they need to do as teachers and administrators.  The district has also provided
much-needed information to these staff members about how technology can
be used effectively with students.  By investing in their staff, this district has
made  teachers into major supporters of the use of technology in the district.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Millcreek Public Schools
Erie, PA
(814) 835-5315
Contact:       Sam Petruso, Technology Coordinator
               Verel Salmon, Asst. Superintendent

Millcreek Public Schools represent an entire district that has taken the
challenge of education reform to heart.  They have changed the instructional
process, using technology as the catalyst, to truly reflect the needs of a
community to produce graduates that have the skill sets necessary to make
them valuable contributors to the society in which they will
live.  A great site for everything from grades K-8.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Bergen County Tech Schools
Hackensack, NJ
(201) 343-6000
Contact:       Len Margolis, Director of the Academy
               John Grieco, Superintendent

Bergen County Tech Schools (BCTS)  has a vision for technology education
that takes the traditional thinking on vo-tech instruction to new heights.
Rather than just focus on the practical trade students, they have re-
engineered their academic programs to appeal to the high achieving student
in math and the sciences.  Technology plays a key role in that process and has
gotten them state-wide acclaim for the innovation of their visions and the
implementation of their facilities.  They also have a very aggressive teacher
training program centered around using technology in the classroom.

*****************************

Diplomat Elementary School
16th Terrace
Cape Coral, FL
(813) 458-0033
Contact:      Linda Caruso, Principal

This southwest Florida elementary school integrates technology throughout the curriculum. The school represents a widely diverse group of children, from Chapter One students to relatively affluent children of mixed races. This was one of the earliest Apple Early Language Connection (AELC) sites. Teachers have implemented AELC and used it as a launching pad for innovative new approaches to teaching and learning. Students have created their own television studio, too.

***********************

Hampton City Schools
1819 Nickerson Blvd.
Hampton, Virginia 23663
(804) 850-5245
Contact:      Dr. Charles Stallard

A great site for management information in K-12 school districts. The entire district is a model of enterprise computing using VITAL, DAL, library information systems, and DataPrism for display of information. Fingertip access to information using PowerBooks by superintendent and his staff.

***********************

Shoreline School District
18560 1st Ave. NE
Seattle, WA 98155
(206) 367-6111
Contact:      Al Morasch

Shoreline is a model for utilization of technology in education. The district office is one of the most state-of-the-art facilities in the state and reflects their commitment to having technology integrated at all levels, from the classroom to the administrators desktop.

***********************

and many more........If you need additional sites to visit, please contact Sue Collins at 408-974-2137.

# Apple Education Research Series:
## *Effectiveness Reports*

Spring 1994

**High school students use their computers to design proposals for agricultural-related businesses. One plans her own pet shop, another an interior "plantscaping" service. They also use the computer to create a resume and write both cover and follow-up letters for their job search.**
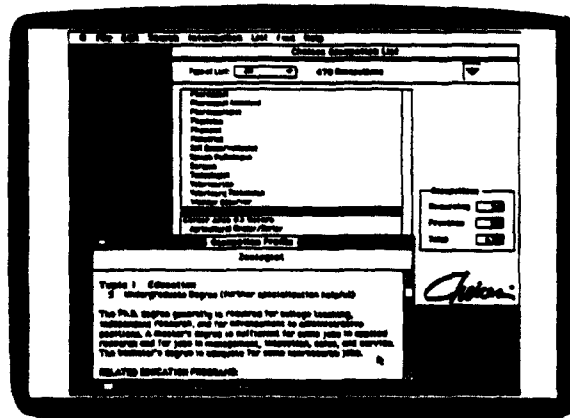
# Preparing Students for the Workforce

### Why use computers to prepare students for the workforce?

The SCANS Report notes that the personal computer "has reconfigured the world of work as has perhaps no other invention since electricity or the assembly line" and points out that students need "enabling" skills—basic skills, thinking skills, and functional skills in the areas of systems, personal interactions, information, resources, and technology—to prepare for today's work force.

Vocationally-oriented education programs teach subjects today that didn't exist a few years ago. Desktop publishing, electronic spreadsheets, word processing, and CAD-CAM are all common to vocational and business education programs in schools. Computers motivate students, providing realistic simulations and productive tasks that match workplace requirements. Students, like workers in business and industry, use computers to manipulate and manage data—to solve problems, to build from ideas, to control technology systems, and to make presentations that help others understand.

Choices, *from Careerware, helps students explore hundreds of occupations matched to their interests and educational program.*

Vocational, tech prep, and business education programs can bridge the high-tech world of students' everyday lives and the increasingly technological environment of the workplace. The computer is central to both worlds; it needs to become a central part of the schools' vocationally-oriented programs, too. People entering most occupations must have basic skills in using computer application programs. Computers need to be part of systematic plans to address the transition between school and work.

### What the research says:

Computers help students master the basic skills needed to participate and succeed in vocational education programs—and in the workforce.[1]

In addition to helping students develop competencies in basic skills, the experience of using technology helps prepare them to use the contemporary tools of the workplace.[1]

# Effectiveness Reports

# Preparing Students for the Workforce

Computer applications in vocational courses with "heavily enriched mathematics content," such as electronics, CAD, or agricultural science, help produce significant gains in mathematics competencies.[3]

Writing instruction using word processing improves the students' quality of writing as well as their attitudes toward writing.[4]

## Citations for research results:

[1] Dees, A. (1990). Basic skills go high tech. *Vocational Education Journal*, 65(1), 30-33.

[2] Imel, S. (1992). Computer-assisted instruction in vocational education. Columbus, Ohio: ERIC Clearinghouse on Adult, Career, and Vocational Education. (ED 347 327)

[3] Copa, G.H., & Copa, P.M. (1992). Vocational education. In Marvin C. Alkin, (Ed.), *Encyclopedia of Educational Research* (Sixth Edition). New York: Macmillan.

[4] Schramm, R.M. (1991). The effects of using word processing equipment in writing instruction. *Business Education Forum*, 26, 7-11.

## Things to read:

Association for Supervision and Curriculum Development. (1992) Education for employment (special issue). *Educational Leadership*, 49(6).

Tommye Lou Grenn, et al. (1992). How I use computers in. . . *Vocational Education Journal*, 67(3), 25-29.

Barbara Malpiedi Kirby (1992). On the cutting edge: A review of state-of-the-art instructional technology. *Vocational Education Journal*, 67(3), 32-33; 53.

V. Wayne Klemin (1993). Multimedia and business education. *Business Education Forum*, 28, 27-30.

N. L. McCaslin & Robert M. Torres (1990). Personal computers—More than calculators and word processors! *The Agricultural Education Magazine*, 64(12), 22-23.

Rutherford, Brian (1992). Using the Macintosh computing environment to move from industrial to technology education. *School Shop/Tech Directions*, February, 20-21.

Ernest Savage (1993). Technology education: Meeting the needs of a complex society. *NASSP Bulletin*, 77(554), 41-53.

## Places to call or visit:

Phil Jones, Assistant Principal, Lake Highlands High School, 9449 Church Road, Dallas, TX 75238, 214/553-4220

Ken Matheson, Superintendent, Mendocino Unified School District, P.O. Box 1154, Mendocino, CA 95460, 707/937-5868

Steve Simms, Technology Teacher, West Junior High, 1309 Holly Drive, Richardson, TX 75080, 214/470-5359
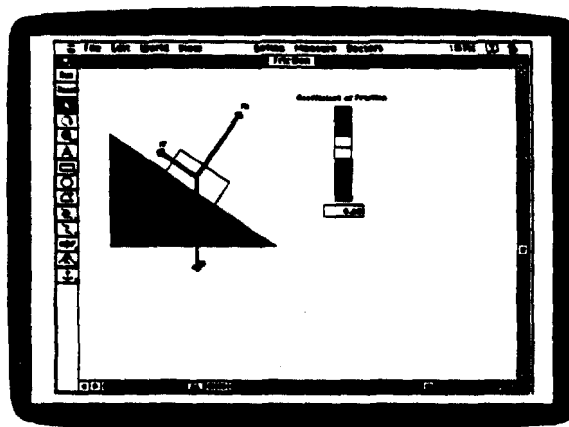
**After their science teacher introduces his favorite classroom tool—*SensorNet*, a way to collect and analyze laboratory data using computer probes—students start coming in before and after school to practice their pH labs, do temperature studies, and learn to manipulate the data for class presentations.**

# High School Science

## Why use computers in science instruction?

To reach the National Educational Goals for the Year 2000, students must master scientific problem-solving skills. And there is no better way to encourage development of these skills than through the use of technology to solve scientific problems. This approach focuses on a classroom environment that is rich in opportunities for cooperative learning; that is organized around themes, not textbook approaches to scientific disciplines; that offers an abundance of interdisciplinary, real-world problems for students to tackle; and that shifts the responsibility for learning to the student.

The computer is central to this way of teaching and learning. Using multimedia applications, students have access to vast visual and audio collections of scientific data—pictures to help explain phenomena, to use for presentations, and to help students who learn best visually. Microcomputer-based laboratories can measure time, temperature, voltage, pH, light intensity, and force. And students can take frequent and reliable measurements without worrying about the calculation necessary to portray the data—and they can manipulate that data, asking the "What-if?" questions that practicing scientists ask.

Interactive Physics, *from Knowledge Revolution, lets students explore scientific principles by manipulating objects and their environment.*

## What the research says:

When the computer is used to do what couldn't easily be done without computers, greater achievement gains are seen and attitudes toward science improve.[1]

Students learn more efficiently when they can watch the science event and its real-time graphic representation simultaneously. Just using computers for graphing seems to aid students' understanding of science concepts and removes the drudgery of creating the physical graph.[2]

Computerized simulation expands classroom inquiry and improves learning. Working with simulations encourages the students to think hypothetically and to use complex strategies with variables.[3]

Learning-disabled (LD) students using computer simulations score significantly higher than did traditionally taught students—both LD and non-LD—on recall of basic information and problem-solving skills.[4]

# Effectiveness Reports

# High School Science

When working with complex models, students using the computer seem able to grasp and apply systems thinking to analysis and even transfer the concepts from one science area to another.[5]

Computer modeling and visualization in physics allow advanced science students to spend more time in active scientific inquiry.[6]

## Citations for research results:

[1] Lavoie, D.R. & Good, R. (1988). The nature and use of prediction skills in a biological computer simulation. *Journal of Research in Science Teaching, 2(5)*, 335-360.

[2] Brasell, H. (1987). The effect of real-time laboratory graphing on learning graphic representations of distance and velocity. *Journal of Research in Science Teaching, 24(4)*, 385-395. Also, see Linn, Marcia C. Layman, J.W. & Nachmias, R. (1987). Cognitive consequences of microcomputer-based laboratories: Graphing skills development. *Contemporary Educational Psychology, 12*, 244-253.

[3] Mintz, R. (1993). Computerized simulation as an inquiry tool. *School Science and Mathematics, 93(2)*, 76-80. Also, see Rivers, R. and Vockell, E. (1987). Computer simulations to stimulate scientific problem solving. *Journal of Research in Science Teaching, 24(5)*, 403-415.

[4] Woodward, J. Carnine, D., & Gersten, R. (1988). Teaching problem-solving through computer simulations. *American Educational Research Journal, 25(1)*, 72-86.

[5] Mandinach, E.B., et al. (1988). The impact of the systems thinking approach on teaching and learning activities. Educational Testing Service Report. (ED 305 928) Also, see Mandinach, E.B. (1988). *The cognitive effects of simulation modeling software and systems thinking and learning and achievement*. Paper presented at the American Education Research Association Convention.

[6] Shore, L.S., et al. (1992). Learning fractals by "doing science": Applying cognitive apprenticeship strategies to curriculum design and instruction. *Interactive Learning Environments, 2(3&4)*, 205-226.

## Things to read:

Leslie Eiser (1992). Multimedia science programs: Moving science education beyond the textbook. *Technology and Learning, 12(6)*, 16-33.

Randolf Tobias (1992). Math and science education for African-American youth: A curriculum challenge. *NASSP Bulletin, 76(546)*, 42-55.

Ronald Aust (1991). Computer networking strategies for building collaboration among science educators. (ED 347 058)

John LeBaron & Rebecca Warshawsky (1991). Satellite teleconferencing between Massachusetts and Germany. *Educational Leadership, 48(7)*, 61-64.

## Places to call or visit:

Jim Nazworthy, Physics Teacher, John Biggerstaff, Math Teacher, Lee's Summit High School, 400 East Blue Parkway, Lee's Summit, MO 64063, 816/524-7151

Ken Schnobrich, Science Department Chairperson, Clarence Senior High School, 9625 Main Street, Clarence, NY 14031, 716/759-8311

Gene Nelson, Science Teacher, Bullard High School, 5445 North Palm, Fresno, CA 93704, 209/441-3966

Mike Froning, Faculty Chair, Alabama School of Fine Arts, 700 18th Street North, Birmingham, AL 35203, 205/328-3143

**To help inspire at-risk students to write, a high school teacher begins with an exercise using *SimCity*. First, students create a city in which half the population is poor and the other half is wealthy. Using this imaginary city as background, students create characters, develop a plot, and write short stories.**

# High School Writing

### Why use computers for high school writing instruction?

At the secondary school level, writing connects all subjects. Writing in the subject areas helps students improve their critical thinking, which, for any course, means restructuring ideas, expressing them, and truly understanding them. This process involves a student in a collaboration that includes him or herself, other writers, and the teacher.

The writing process requires motivation. Teachers find the computer the ideal tool to increase student motivation and to help students make connections among the subject areas. The computer turns the high school classroom into a learning environment where communication is accessible. Authentic writing—writing for a real audience—dramatically increases the motivation of low achievers and is readily accomplished using telecommunications. Tools for idea mapping, desktop publishing programs, and reference materials help student writers become more creative and proficient, willing to develop and express their ideas with pride and confidence.
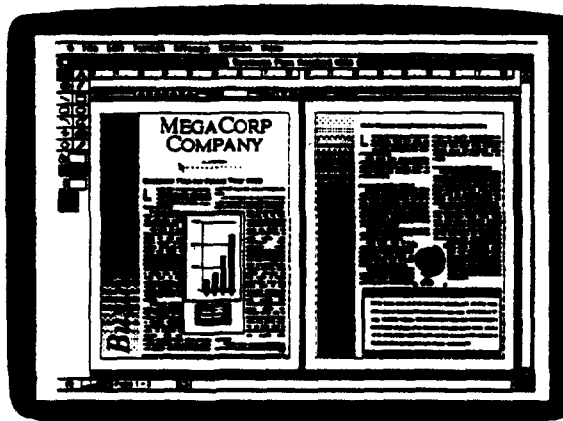
ClarisWorks, *from Claris Corporation, lets students combine graphics with text to produce professional-looking reports.*

### What the research says:

When students use word processing to write, there is a significant improvement in their attitude toward self, teachers, and writing.[1]

Low-achieving writers benefit from participation in telecommunications-based writing projects in which they are intrinsically motivated in a real communications environment.[2]

Urban LEP students improve their writing by using word processing (and become more positive about school and about writing). Support from word processing includes: overcoming illegible handwriting, conferencing about assignments, extending the length of assigned writing, overcoming fear of errors, and encouraging student collaboration.[3]

Reviews of the research on the effects of word processing indicate that there is an increase in revisions, fewer mistakes, and more correction of them. And when word processing use is combined with an effective teaching model, students achieve at a higher level than those not using a word processor.[4]

# Effectiveness Reports

# High School Writing

Studies show significant performance differences between students using computers and those writing essays by hand. Students who use computers receive higher performance scores and higher grades on their essays. Computer essays contain fewer punctuation errors, and have a greater average sentence length and a greater number of complex sentences.[5]

## Citations for research results:

[1] Kurth, R. (1987). Using word processing to enhance revision strategies during student writing activities. *Educational Technology*, 27(1), 13-19.

[2] Spaulding, C. & Lake, D. (1991-1992). Interactive effects of computer network and student characteristics on students' writing and collaborating. Cited in Riel, M. (1992). Approaching the study of networks. *The Computer Teacher*, 19(4), 7-9, 52.

[3] Silver, N.W. & Repa, T.J. (1993). The effect of word processing on the quality of writing and self esteem of secondary school English-as-a-second-language students: Writing without censure. *Journal of Educational Computing Research*, 9(2), 265-283.

[4] Snyder, I. (1993). Writing with word processors: A research overview. *Educational Research*, 35(1), 49-65.

[5] Robinson-Staveley, K. & Cooper, J. (1990). The use of computers for writing: effects on an English composition class. *Journal of Educational Research*, 6(1), 41-48.

## Things to read:

B.G. Erickson (1989). Revision for the restless: Peer editing for Macintosh. *The Computer Teacher*, 17(1), 54-55.

Peggy Anderson (1993). Connecting with "the real world." *Momentum*, 72-73.

Sarah Schrire (1993). The computer, the class and the English teacher. *English Teachers' Journal*, 46, 21-23.

## Places to call or visit:

Wayne Robinson, Principal, Sandy Creek High School, 360 Jenkins Road, Tyrone, GA 30290, 404/969-2842

Claron Hanefeld, Technology Coordinator, East Allen County Schools, 1000 Prospect Avenue, New Haven, IN 46774, 219/493-3761
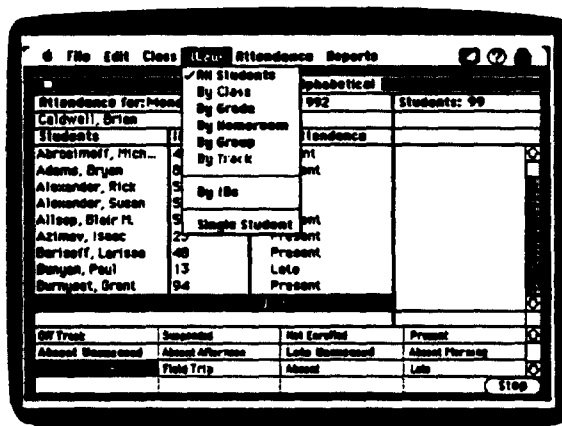
**Middle school teachers, administrators, and professional staff use their PowerBook computers to make record keeping easy and increase productivity. An unexpected, but powerful, outcome is increased collaboration.**

# Management and Administration

## Why use computer-based management tools?

Principals and other school administrators have enormous responsibilities to communicate with teachers, students, and parents; find and analyze information; manage people; and administer discipline. Technology helps school leaders accomplish these tasks with greater efficiency and productivity.

Computer networks, electronic mail, presentation software, desktop publishing, and computer databases are all components of technology that make a school administrator more effective in accomplishing his or her everyday tasks. For instance, local telephone lines allow meetings, workshops, and conferences to be held over a network, eliminating the need for travel and time away from school. Electronic mail allows for communicating with staff and parents, removing the boundaries of time and place. And powerful desktop publishing capabilities permit school administrators to make professional presentations to parents and colleagues.

*Administrators can analyze attendance in a variety of ways with Chancery's Mac School Student Information System.*

## What the research says:

Providing computers and printers (and training) to all teachers and school administrators, for at home or in school use, increases both administrative productivity and feelings of professionalism.[1]

Principals using technology for administrative purposes in their schools report an increase in autonomy from district office control and the ability to be more personally productive using word processing.[2]

Principals who learn about both administrative and educational applications of technology feel more confident in dealing with staff requests and purchase decisions.[3]

Establishing a "homework hotline" using telecommunications increased homework

# Effectiveness Reports

# Management and Administration

time by two hours/student/week—and students continued getting schoolwork from the system during the summer.[4]

Elementary teachers provided with laptop computers tend to increase their use of the computers for administrative applications, especially record keeping and grading.[5]

Teachers with laptop computers report significant pedagogical changes: increases in the amount of inquiry-oriented instruction and project-based activities, increased collaboration with teachers, and more communication with students.[6]

## Citations for research results:

[1] Rockman, S., Pershing, J. & Ware, W. (1992). Productivity, professionalism, and empowerment. Indianapolis: Indiana Department of Education.

[2] Cannings, T.R. and Polin, L. (1987). The computer as an administrative tool: A survey of 30 high schools. In A. Bank and R. Williams (Eds.), *Information systems and school improvement: Inventing the future*. New York: Teachers College Press, 39-56.

[3] Rockman, S. and Sloan, K.R. (1993). A program that works: Indiana's principals' technology leadership training program. Indianapolis: Indiana Department of Education.

[4] Mountain, L. (1992-1993). Doing homework on a telecommunications network. *Journal of Educational Technology Systems, 21*(2), 103-107.

[5] Weast, J.D., Parry, J. and Peterson, T. (1993). Empowering middle school teachers with portable computers. *ERS Spectrum, 11*(3), 22-26.

[6] McMillan, K. and Honey, M. (1993). Year one of Project Pulse: Pupils using laptops in science and English. *Technical Report No. 26*. New York: Center for Technology in Education. (ED 358 822)

## Things to read:

Judy J. Harris (1993). Computer use in elementary schools: An update. *Principal, 72*(3), 50-51.

Thomas F. Kelly (1991). Effective schools and computers. *Principal, 70*(3), 53-54.

Peter H. Lewis (1991). The Technology of Tomorrow. *Principal, 71*(2), 6-7.

Lynne Schrum (1992). What is distance education? *Principal, 71*(3), 56-57.

K-12 computer networking, *ERIC Review, 2*(3) Winter 1993. (ED 355 940)

Dan H. Wishnietsky (1991). Using electronic mail in an educational setting. Bloomington, IN: Phi Delta Kappa *Fastback*, 16.

## Places to call or visit:

Tom Petersen, Library Media Supervisor, Sioux Falls Public Schools, 1116 West Ninth Street, Sioux Falls, SD 57104, 605/331-7951

Martha Lyle, Principal, L.D. McArthur Elementary, 330 East Ten Mile Road, Pensacola, FL 32534, 904/484-5115

Eileen Steele, K-12 Computer Coordinator, Lafayette School Corporation, 2300 Cason Street, Lafayette, IN 47904, 317/449-3230

Ken Matheson, Superintendent, Mendocino Unified School District, P.O. Box 1154, Mendocino, CA 95460, 707/937-5868

History students use computers, videodiscs, and a variety of software to study the Middle Ages. After viewing 14 different castles on the *Salamandre* videodisc, they choose a favorite, then explore the *National Gallery of Art* videodisc to find art of the same period.

# Middle School Social Studies

## Why use computers in teaching social studies?

Social studies education should stimulate high levels of thinking and analysis. Computers and other technologies provide powerful tools for learning concepts, testing generalizations, solving problems, and processing information in order to make decisions. Students can use the technology to brainstorm ideas, test hypotheses, outline their thoughts, organize their ideas, and connect one idea to the next. With technology, students can work together, sharing thoughts and resources as they collect data, solve problems, and develop new ideas. Students can use multimedia to create exciting, informative presentations that engage their classmates.

Middle school students are motivated and challenged by computers and related technologies. Schools can enhance these interests by providing new instructional approaches that use the computer—from simulations of historical events to "What-if?" questions of national databases, from geography games to powerful research and presentation tools. In the social studies, technology can help make connections to the real world, provide access to enormous amounts of information, and encourage collaborative work.

## What the research says:

The computer can be a powerful tool for the delivery of critical-thinking and problem-solving activities in the social studies classroom. At the same time, the computer offers the opportunity for successful collaborative learning.[1]

Computers help students organize and manipulate information and improve performance in problem solving.[2]

Students can use computers to graph, help interpret information, and apply that knowledge in social studies.[3]

Students using computers in a history class demonstrated increased motivation and recall and took less time to complete the unit.[4]

## Citations for research results:

[1] Repman, J. (1993). Collaborative, computer-based learning: Cognitive and affective outcomes. *Journal of Educational Computing Research, 9*(2), 149-163.

[2] White, C.S. (1987). Developing information-processing skills through structured activities with a computerized file-management program. *Journal of Educational Computing Research, 3*(3), 355-375.

[3] Jackson, D., Berger, C. and Edwards, B. J. (1992). Computer-assisted thinking tools: Problem solving in graphical data analysis. *Journal of Educational Computing Research, 8*(1), 43-67.

# Effectiveness Reports

# Middle School
# Social Studies

'Yang, Y.C., (1991-1992). The effects of media on motivation and content recall: Comparison of computer and print based instruction. *Journal of Educational Technology Systems*, 20, 95-105.

## Things to read:
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## Places to call or visit:
Camille Barr, Principal, Brown Barge Middle School, 151 East Fairfield Drive, Pensacola, FL 32503, 904/444-2700

Mary Anne Charron, Principal, Trickum Middle School, 948 Cole Drive, Lilburn, GA 30247-5498, 404/921-2705

Claron Hanefeld, Technology Coordinator, East Allen County Schools, 1000 Prospect Avenue, New Haven, IN 46774, 219/493-3761

**Ninth-graders create multimedia science presentations for parents and local scientists and use half the time to explain where they locate information, how they organize it, and why they make the information choices they do.**

# Middle School Science and Mathematics

### Why use computers for middle school science?

An inquiry approach to middle school science and mathematics is strongly endorsed by both NCTM and NSTA. In middle schools, students benefit from collaborative learning and the opportunity to explore and try out alternatives. They need content and processes connected to the world around them. The computer can play a vital role in making science and mathematics real, dynamic, and engaging for students.

Technology allows for the "doing" of science, providing hands-on experiences for students. There are a growing number of science learning opportunities on classroom networks, as part of telecommunications services, and in the form of microcomputer-based laboratories. Simulation software allows students to interact with environments otherwise unavailable to them.

Innovative software encourages students to apply math skills to real-world problems in order to gain a deeper understanding of the concepts. Technology helps them make connections, analyze ideas, and develop conceptual frameworks for thinking and problem solving. They can do real science, apply mathematics, and share their findings with others.
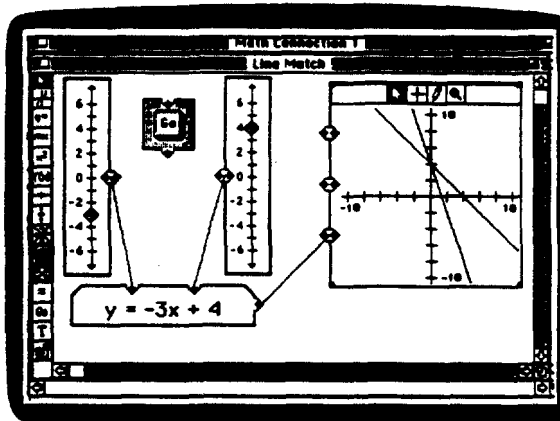


Math Connections: Algebra I, *from Sunburst/WINGS for learning, lets students work with on-screen "objects" that display variables, functions, and graphs.*

### What the research says:

Microcomputer-based laboratory experiments improve the knowledge of science concepts and processes, and encourage the application of multiple modalities in authentic science experiences.[1]

Using computers for performing graphing functions seems to aid students' understanding of science concepts and removes the drudgery of creating the physical graph.[2]

Students who used computers to create computational models of scientific processes dealt with more complex problems than those without modeling software.[3]

Computer tools in science help students understand and master high-level science concepts, working through a progression of conceptual levels.[4]

# Effectiveness Reports

# Middle School Science and Mathematics

Students who use computers for math problem solving improve interpersonal relationships and increase creativity. [5]

Students spend more time analyzing and interpreting data when they use computers in an integrated, problem-based curriculum. [6]

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## Places to call or visit:

Ruthie Blankenbaker, Technology & Curriculum Coordinator, Park Tudor School, 7200 North College Avenue, Indianapolis, IN 46240, 317/254-2716

Steve Simms, Technology Teacher, West Junior High, 1309 Holly Drive, Richardson, TX 75080, 214/470-5359

Middle school students create
an interactive report about
Greek mythology. This
"yearbook" begins with a
picture showing students
dressed as gods or
goddesses. A click on any
face displays information
about that character.

# Middle School Language Arts

## Why use computers in language arts?

The best way to learn language is to create it. A language arts classroom should be a work center where students create professional-looking language productions, from prose to poetry to plays. And they should work together—collaborative learning is especially effective at the middle school level. Computer networks link writers with one another, providing the real audience adolescent learners need, along with peer interaction for revision and conferencing. Through the network, students share comments or collaborate on the same document from computers in different places. Telecommunications extends the network to others around the world. In these ways, technology fosters exploration and production with words and ideas.

Reading is also an important part of the middle school language arts curriculum. Technology can support the development of comprehension skills by posing questions and providing "story support." Telecommunications and multimedia technologies create functional language-learning environments where reading skills are developed in the context of accomplishing a task. Computer programs surround and support the act of reading with access to hypertext, graphics, sound, music, animation, and video. Click on a word and find out how it sounds, or what it means, in English or in Spanish. The computer can even record a child's oral reading and play it back for his own analysis. Technology allows a fully integrated approach to the language arts.

## What the research says:

Reviews of the research have found that when word processing use is combined with an effective teaching model, students achieve at a higher level than those not using a word processor.[1]

Studies of revision on the word processor point to an increase in the frequency of revision, fewer mistakes, and more corrections.[1]

Remedial reading students using computer reading games to develop and reinforce reading comprehension skills showed significant gains on reading achievement and improved attitudes toward reading.[2]

When measured holistically, students using laptop computers to keep journals, write stories, and complete assignments in science and English classes showed marked improvement in their ability to communicate persuasively, organize ideas logically, and use a broad vocabulary effectively.[3]

Students participating in writing activities over telecommunications show dramatic improvements in writing quality and attitudes toward writing, and often improve their reading comprehension and vocabulary, as well.[4]

# Effectiveness Reports

# Middle School
# Language Arts

Middle school students using computers improve the quality of their writing and learn knowledge-transforming and text-construction strategies. More experienced writers improve their existing competencies in creating narrative.[5]

Students in an inquiry-based curriculum who used a variety of technologies, including CD-ROM, videodiscs, and computers to organize, plan, and collect information and write reports, acquired significant amounts of content knowledge and developed a positive self-image.[6]

A computer-managed spelling instruction program improved seventh-grade spelling performance significantly.[7]

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## Places to call or visit:

Claron Hanefeld, Technology Coordinator, East Allen County Schools, 1000 Prospect Avenue, New Haven, IN 46774, 219/493-3761

Joel Orleck, Computer Coordinator, Meigs Magnet School, 713 Ramsey Street, Nashville, TN 37206, 615/244-9261

**In a kindergarten class, students create small books on the computer. One writing project that helps students recognize both numbers and letters involves making a "phone book" that collects classmates' names and numbers.**

# Elementary School Language Arts

## Why use computers for language acquisition?

The earliest writers, kindergartners and first-graders, use language to tell stories and illustrate them—wanting to communicate their own experiences and ideas. When writing or listening to a story, or working on projects using paint or graphics programs, children are also using spelling and vocabulary functionally. And as children use words, they begin to read.

Children write freely on the word processor. Some researchers find that children's word processing is more like speech than other writing, and children choose to spend more time on language acquisition in classrooms with a word processor. When children are motivated by technology, learning is fun and students become actively involved in the learning process.

The opportunity to develop language skills occurs when listening, reading, speaking, and writing skills are combined in real tasks. Language arts projects, such as having students use computers to develop a newspaper to be shared with parents and other students, can dramatically improve language mechanics while, at the same time, enhance attitudes toward writing and other language skills.

*Davidson's* Kid Works 2 *provides an exploratory environment for writing, drawing, and listening.*

## What the research says:

Children quickly learn to use word processing software and often do better writing than with pencil and paper.[1]

Using word processing results in fewer grammar, punctuation, and capitalization errors, especially among students with low abilities.[2]

Authentic writing with computers is an effective way of learning language mechanics. When combined with the use of telecommunications, such as a cooperative development project, improvements show up on both holistic assessments and standardized tests.[3]

When children use a computer to study spelling, they are more engaged and, as a result, achieve higher spelling scores.[4]

# Effectiveness Reports

# Elementary School
# Language Arts

When teachers learn about computers, this new knowledge helps their students' writing improve, mainly because they give students more opportunity to write on the computer.[5]

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## Places to call or visit:

Alice Lewandowski, First grade teacher, Solon Robinson School, 601 Pettibone Street, Crown Point, IN 46307, 219/663-2525

Liz Whitaker, Coordinator Instructional Technology, Drachman Elementary School, 549 S. Convent Ave., Tucson, AZ 85701, 602/798-2735

Sandy Andrews, Assistant Principal, Lake Wylie Elementary School, 13620 Erwin Road, Charlotte, NC 28273, 704/343-3680

Cynthia Cavanagh, Coordinator of Educational Technology, William Seach Elementary School, 770 Middle Street, Weymouth, MA 02188, 617/335-7589

Using images from a biology videodisc, fourth-graders learn about plants and animals in the rain forest. Then, by connecting videodisc images to their own text, they create an interactive report for their classmates to read.

# Elementary Science and Mathematics

## Why use computers for elementary science and mathematics?

Children learn by doing, and the computer can play a vital role in making science and mathematics dynamic and engaging for students. Software designed for the elementary grades can be used effectively to teach everything from colors and shapes to the most complex science and math skills. These programs—which build on a child's natural tendency to play—focus on problem solving, reasoning, and communications.

In science, computers help make the subject matter real and accessible to children. Using computer links to telecommunications networks, students in different parts of the world can participate in projects in which they compare the length of shadows cast by a one-meter stick at different latitudes or calculate the Earth's circumference. In mathematics, students are encouraged to apply math skills to real-world problems in order to gain a deeper understanding of the concepts. Technology helps students make connections, analyze ideas, and develop conceptual frameworks for thinking and problem solving. They do real science, apply mathematics, and share their findings with others.

Technology gives students a chance to be in control, and allows them to do things they once only read about in textbooks and workbooks.
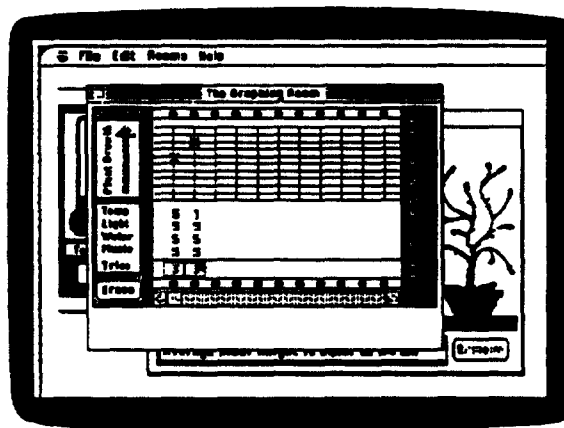


Botanical Gardens, *from Sunburst/WINGS for learning, lets students control many variables in simple experiments.*

## What the research says:

Computers help elementary students of all ability levels to learn science content and to increase their logical thinking and problem-solving skills.[1]

Students show greater achievement on standardized tests after using computers for math problem solving.[2]

Telecommunications projects in science help students develop both specific science concepts and global awareness while using computer tools.[3]

Students working collaboratively to explore science concepts are effective and successful when they use a local-area network.[4]

# Effectiveness Reports

# Elementary Science and Mathematics

Children can use a computer-based manipulative math environment that provides more control and flexibility than hands-on materials, helping to integrate objects and symbols in a visual approach where real manipulatives are not feasible.[5]

Children using computers in mathematics are more independent learners and prefer learning on computers to learning with worksheets or precision teaching.[6]

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## Places to call or visit:

Marguerite Hart, Technology Coordinator, Metropolitan School District of Washington Township, 3801 East 79th Street, Indianapolis, IN 46240, 317/226-4239

Keith Hanson, Science & Technology Resource Teacher, Franklin Park Magnet School, 2323 Ford Street, Fort Myers, FL 33916, 813/332-1750